

Crystal Growth of Artificial Snow

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The Asahi Shimbun Co., the leading newspaper company of Japan, did GAS experiment twice in 1983 and succeeded in observing the growth of artificial snow crystals under weightlessness.

The snow crystals grown onboard the Space Shuttle were polyhedrons looking like spheres, which were quite unlike snow crystals produced in experiments on the earth.

§ DEVICE FOR THE EXPERIMENTS

The heart of the device for the experiments is two copper boxes, each 4 cm in both depth and width and 10 cm in height. On one side of each copper box, semiconductor thermo-modules(cooling units) are attached. The thermo-modules can lower the temperature in the box to -15 degrees centigrade in about 10 minutes. On the top of each copper box is a water container made of porous sintered metal which is similar to a sponge. In the water container is a electric heater to vaporize the water at about 25 degrees centigrade.

As shown in the Figure 1, there is a heater to sublime silver-iodine, fine particles of which serve as seeds for snow crystals.

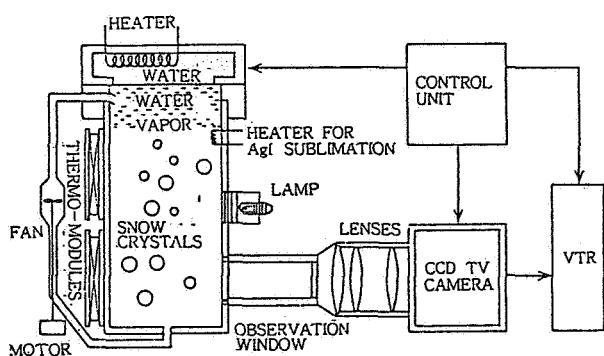


Figure 1. Structure of the artificial snow experiment.

There is a observation window on the other side of the copper box, through which the snow crystals are observed with TV cameras and recorded onto video-tapes.

For the first experiment in April, the above-mentioned device was used.

But after the failure of the first experiment, small fan was attached to the copper box in order to see the effect of air flow in the box on the growth of the snow crystals.

For this device, four CCD TV-cameras

and four VTRs are used which are all for home use. Thus we have verified that some inexpensive hardwares for home use can be utilized for GAS experiments.

Some characteristics and features of the device are shown in table 1.

TABLE 1

S RESULT OF THE EXPERIMENT

(1) First Experiment

The first experiment was carried out on STS-6, which was the first flight of the Challenger and was launched on April 4, 1983.

But the VTRs failed to record any snow crystals. The post-flight investigation revealed that the coldness of the space lowered the temperature inside the GAS canister to -7 degrees centigrade. Thus the water in the container was frozen at the start of the experiment. The heater inside the container was of only 1 watt, so the temperature of the water could not be warmed up to 25 degrees centigrade. The experiment was repeated for four times but even at the last experiment the temperature of the water was about 7 degrees centigrade.

Activation of Small Fan

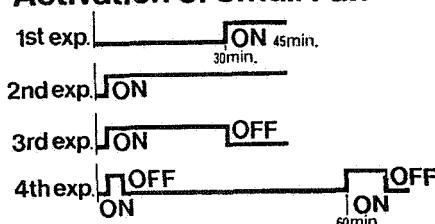


Figure 2.

It was inferred that, as a result, the amount of the water vapor generated was small. Thus snow crystals were not formed. And it is also suspected that the lack of thermal convection under weightlessness prevented the water vapor to travel 60 mm distance from the exit of the water container to the field of the view of the observation window.

So the device was improved. The power of the heater was raised up to 4.5 watt and an auxiliary fan of a blower type was installed in each box. The diameter of the fan was 1.5 cm. By turning this fan on and off, the comparative studies were conducted.

The experiment was repeated twice for each box, totalling four times. In each experiment, the mode of activation of the fan was changed as shown in Figure 2.

(2) Second Experiment

The second experiment was carried out on STS-8, which was the third flight of

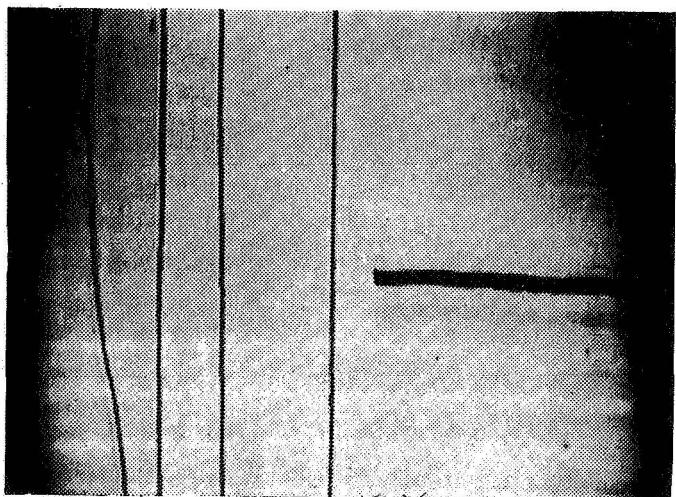
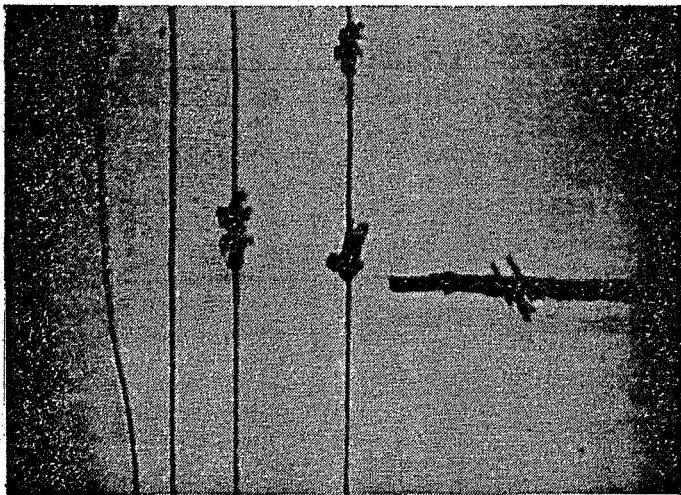
the Challenger and was launched on August 30, 1983. This time the experiment was successful. The results of the experiments was recorded on four video cassettes with a total time of about six hours and 50 minutes.

In the second and third experiments, in which the auxiliary fan was activated to make an artificial breeze for the most of the experimental time, hexagonal and irregularly shaped snow crystals were formed on the four rabbit hairs which were installed in front of the observation window in order to catch the snow crystals. And frost was formed on the copper wire which is also installed in front of the the observation window in order to investigate the growth of the frost. The results of these two experiments were just as same as the results of the experiments which were carried out hundreds times on the ground. One of the result of the third experiment is shown above. Four vertical lines are rabbit hairs and a horizontal line is a copper wire .

But the results were different in the first experiment, in which the fan was not activated for the initial 30 minutes and thus the weightlessness was maintained, and in the fourth experiment, in which the fan was activated for five minutes when the silver-iodine was sublimated and then the weightlessness was maintained for about 50 minutes.

No changes appeared when the fan was not activated in the field of view of the TV-cameras as shown in the picture (Right).

But as soon as the fan was activated, crystals of artificial snow, which were reasonably supposed to be formed and grown under weightlessness, were brought into the field of view of the TV-cameras by the breeze the fan made.



The crystals were almost spherical looking like a ball. The diameter of the largest crystal was about 3 mm.

One crystal traveled the field of the view from left to right and finally collide with a rabbit hair. At the collision the shape of the sphere was not changed. Thus, it was confirmed that the sphere was not a water droplet but a snow crystal.

One scene of the first experiment is shown in serial pictures on this page.

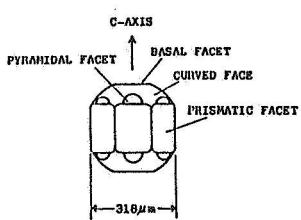


Figure 3. Dr. Takehiko Gonda analysed the pictures and supposed the shape of the snow crystal as Figure 3.

§ ACKNOWLEDGEMENT

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